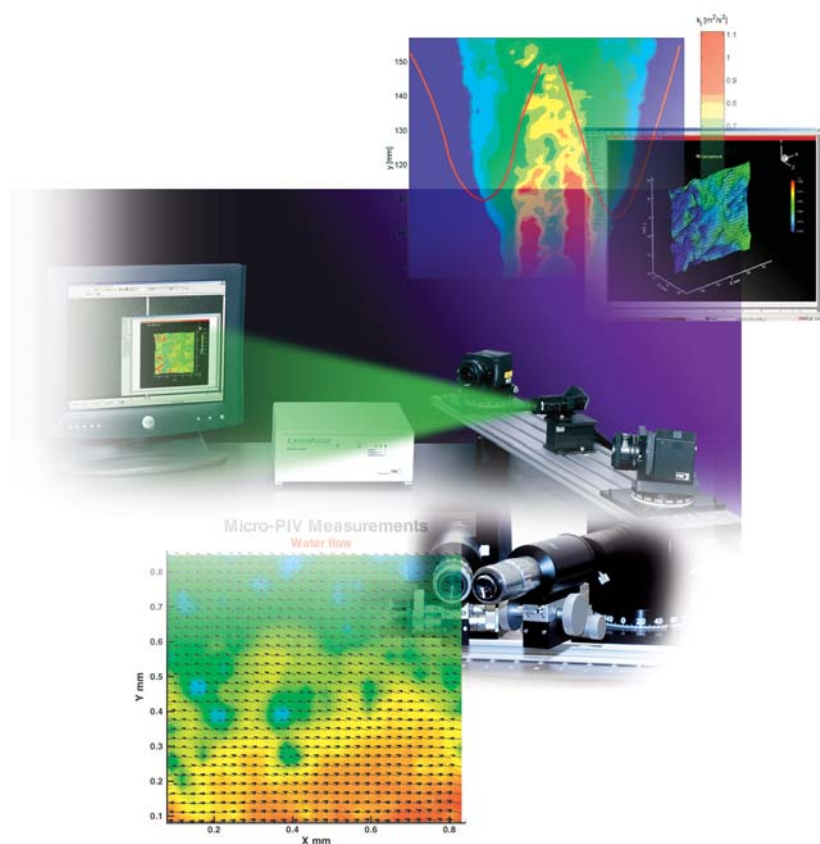


# POWERVIEW™ Stereoscopic PIV System

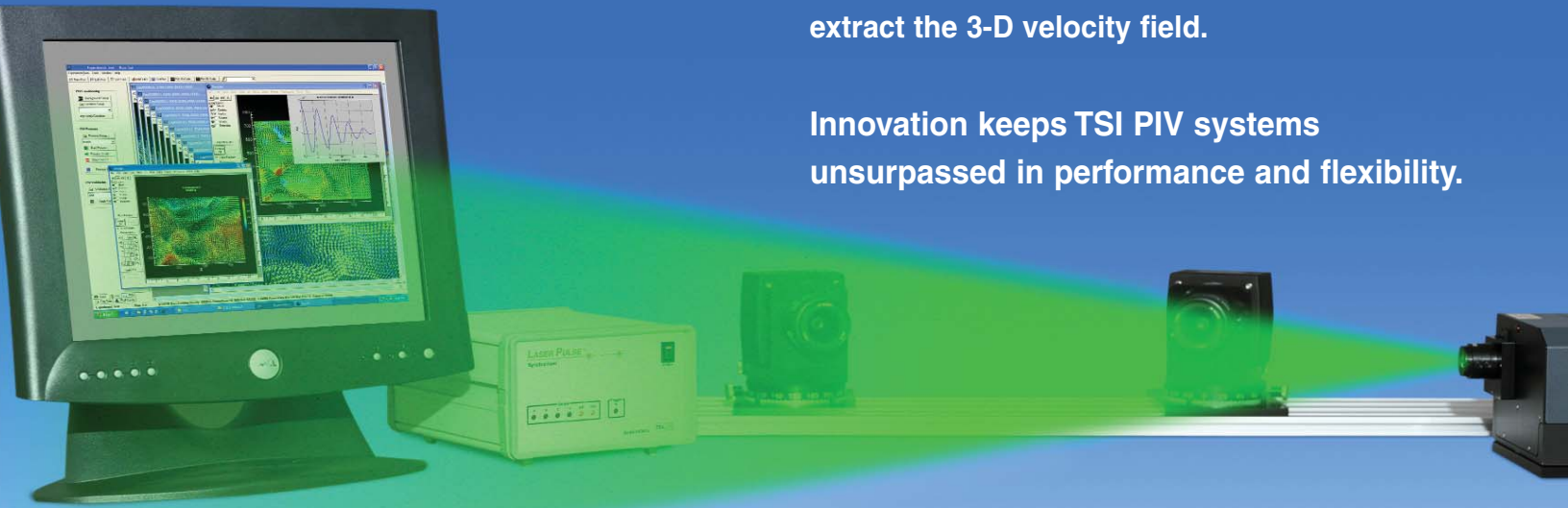
*The Latest Advancement  
In PIV Technology for  
Three-Component  
Velocity Measurements*



Since introducing the first commercial PIV system in 1988, TSI has led in hardware and software innovation. TSI first exploited new CCD camera and frame grabber technology. TSI routinely develops and implements patented hardware and data analysis concepts. And TSI regularly exploits advances in computer system speed and capability.

More recently, TSI developed the first optimized stereoscopic PIV system where stereoscopic imaging of particles provides global measurement of three orthogonal velocity components. Two cameras are positioned to view the light sheet obliquely, and the captured particle image displacements contain the influence of all three velocity components. Innovative data reduction techniques then identify the true image displacements and extract the 3-D velocity field.

Innovation keeps TSI PIV systems unsurpassed in performance and flexibility.



### **Today, TSI stereoscopic PIV systems offer unsurpassed capability:**

- On-line measurement/display of three velocity components
- On-line PIV image display
- POWERVIEW PIV Cameras with very short frame-straddling times
- On-line mapping function—eliminates the need to measure camera angles
- Optimum Scheimpflug camera configuration
- DPDS target for generating mapping function—no need to traverse the target
- High-speed camera interfaces for on-line data transfer
- Back-, forward- or side-scatter camera positioning
- Optional remote focusing and Scheimpflug adjustment

## POWERVIEW Family of PIV Cameras

TSI designed and developed the POWERVIEW family of cameras for PIV applications. These cameras offer high spatial resolution, short frame-straddling times, programmable camera parameters and other innovations vital to accurate flow measurements. POWERVIEW cameras also incorporate a unique CCD masking arrangement specially designed to protect CCD circuitry and maximize camera performance when imaging flow fields illuminated by laser light. Combined with the patented Hart correlation technique, these features provide an unparalleled ability to examine practical flow fields with very high resolution and accuracy



POWERVIEW Plus 4MP Camera



POWERVIEW Plus 2MP Camera

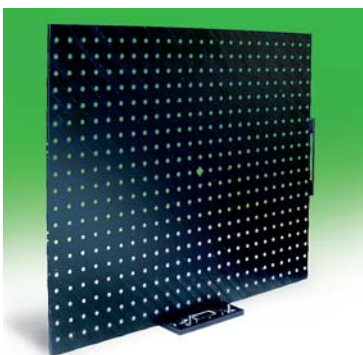
## Optimized Scheimpflug Arrangement

A Scheimpflug camera configuration ensures that all points in the illumination plane (plane of measurement) are brought into focus in the camera image plane, making it adaptable to the widest range of flow measurement applications. The Scheimpflug condition is achieved when the object plane, the image plane and the lens plane intersect at a common point.

To achieve the optimum configuration, a unique camera mounting arrangement that allows rotation of the detector plane with respect to the lens system is employed. Because the cameras rotate about their detector planes, the field of view does not change when the Scheimpflug angle is adjusted, greatly simplifying system alignment. The cameras can be set up in back-, forward- or side-scatter positions with respect to the light sheet.

## Mapping Function Generation and DPDS Target

Since the cameras in the Scheimpflug configuration are generally not normal to the light sheet, angular viewing must be accounted for. A rectangular grid structure imaged in such an arrangement appears as a trapezoid, a situation easily compensated for using a comprehensive mapping function. The influences of refraction through walls and similar optical influences are also overcome.



planes of markers on both sides. It allows mapping function generation without traversing the target. Further, it allows

In TSI systems, the mapping function that establishes the unique relationship between the object plane, or the measurement plane in the flow, and the image planes in the cameras is generated using a target. TSI pioneered the dual plane dual side (DPDS) target that has multiple

the two cameras in a stereoscopic system to be set up in any desired fashion. They can be placed on either side of the light sheet or both on the same side to suit the experimental facility geometry.

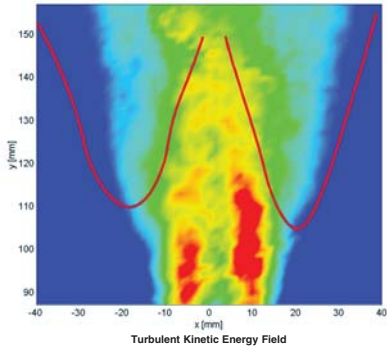
The target has a built-in mirror to position it in the light sheet plane. Unique algorithms, developed as part of the image capture and analysis portion of TSI's INSIGHT™ PIV software, make mapping function generation accurate and easy to accomplish. A unique advantage of this on-line calibration approach is that camera angles and other parameters need not be measured, even for an asymmetrical camera arrangement.



## INSIGHT Image Capture, Data Analysis and Display software

INSIGHT Stereo software provides on-line processing of individual camera image fields and, from them, 3-D vector fields. From the instantaneous 3-D vector fields, detailed statistical flow properties are computed.

Tecplot® software, a comprehensive data visualization package has been integrated with INSIGHT software via a dynamic link library. This lets the user view many fluid mechanics properties on-line, including 2-D and 3-D velocity, vorticity, strain rate, and velocity magnitude fields for both instantaneous and ensemble-averaged conditions.

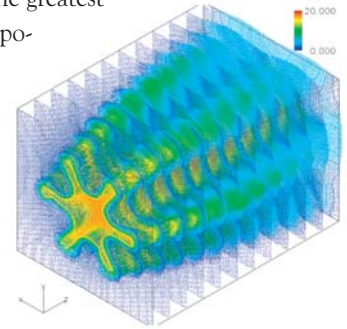


Measurements in lifted jet flame  
(Courtesy Stanford University)

Once the three orthogonal velocity components are obtained, the spatial and temporal variation of statistical properties can be computed and displayed. TecPlot software lets the user animate successive vector files to enhance data interpretation.

The velocity vector data files can be exported to work with other commercial software for further analysis and display. The ability to store and retain raw image fields offers the additional ability to re-analyze images and examine velocity field information. The INSIGHT software vector processing capability also takes full advantage of multiprocessor computer systems to increase processing speed.

A patented Hart Correlation technique, developed specifically for processing PIV images, is one of the greatest advances in PIV technology. It incorporates unique ideas to accelerate processing speed, minimize noise effects, enhance measurement accuracy, increase spatial resolution and increase the size of the measurement region. The UltraPIV analysis capability provided by Hart correlation is part of the INSIGHT software.



Measurements in lobed jet mixing flow  
(Courtesy University of Tokyo)

## Remote control (optional)

For some measurements, access to the experimental facility may be limited or not feasible during the experiment, so remote system control becomes essential. TSI PIV systems offer remote focusing and/or remote Scheimpflug adjustment, features that allow the user to set up and align the sys-

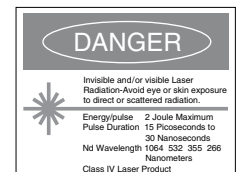


tem remotely. On-line image display, along with analyzed results, make remote control easy and precise. TSI has provided several such stereoscopic systems for automotive tunnel, water tunnel, and underwater measurements.

## The Power of PIV...From TSI

Beyond providing the most powerful state-of-the-art PIV capabilities, TSI systems offer a smooth upgrade path as your needs increase or technology improves. They are designed to fully exploit every gain in computer speed to realize an automatic gain in PIV system performance. TSI systems are used in a wide range of applications, from obtaining all three components of velocity in very large regions to making measurements in microflows.

Tecplot is a trademark of Amtec Engineering, Inc.



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